JC13 Rec'd PCT/PTO 14 JAN 2002

S&H Form: FORM PTO-1390 (2/01)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE **TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371**		ATTORNEY'S DOCKET NUMBER 1454.1208 10/030705
INTERNATIONAL APPLICATION NO. PCT/DE00/02299	INTERNATIONAL FILING DATE 13 July 2000	PRIORITY DATE CLAIMED 14 July 1999

TITLE OF INVENTION
METHOD, SYSTEM AND COMPUTER PROGRAM FOR PRE-PROCESSING

APPLICANT(S) FOR DO/EO/US
Rudolf KODES

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☒ This is an express request to immediately begin national examination procedures (35 U.S.C. 371(f)).
3. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
4. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
5. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
6. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
7. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
8. ☒ An oath or declaration of the inventor (35 U.S.C. 371(c)(4)).
9. ☒ A translation of the Annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 10-15 below concern document(s) or information included:

10. ☒ An Information Disclosure Statement Under 37 CFR 1.97 and 1.98.
11. ☒ An assignment document for recording.
    Please mail the recorded assignment document to:
    a. ☒ the person whose signature, name & address appears at the bottom of this document.
    b. ☐ the following:
12. ☒ A preliminary amendment.
13. ☒ A substitute specification
14. ☐ A change of power of attorney and/or address letter.
15. ☒ Other items or information:

PCT EASY forms filed with International Application; copies of cover page of International Application as published, International Search Report, and International Preliminary Examination Report; Letter to the Examiner Requesting Approval of Changes to the Drawings.

10/030705

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☒ The U.S. National Fee (35 U.S.C. 371(c)(1)) and other fees as follows:

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS	15 -20=	0	x $ 18.00	0.00
	INDEPENDENT CLAIMS	4 -3=	1	x $ 84.00	84.00
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+$280.00	0.00
	BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(4): ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ......$1,040 ☒ International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.........$ 890 ☐ International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but international search fee (37 C.F.R. 1.445(a)(2) paid to USPTO...$ 740 ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provision of PCT Article 33(1)-(4)...........$ 710 ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2) to (4) ....$ 100				890.00
	Surcharge of $130 for furnishing the National fee or oath or declaration later than ☐ 20 ☐ 30 mos. from the earliest claimed priority date (37 CFR 1.482(e)).				0.00
			TOTAL OF ABOVE CALCULATIONS		974.00
	Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed also. (Note 37 CFR 1.9, 1.27, 1.28.)				
			SUBTOTAL		974.00
	Processing fee of $130 for furnishing the English Translation later than [ ] 20 [ ] 30 mos. from the earliest claimed priority date (37 CFR 1.482(f)).				
			TOTAL NATIONAL FEE		974.00
	Fee for recording the enclosed assignment (37 CFR 1.21(h)).				+ 40.00
			TOTAL FEES ENCLOSED		1014.00

a. ☒ A check in the amount of $1,014.00 to cover the above fees is enclosed.
b. ☐ Please charge my Deposit Account No. 19-3935 in the Amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-3935. A duplicate copy of this sheet is enclosed.

21171
PATENT TRADEMARK OFFICE

SUBMITTED BY: STAAS & HALSEY LLP			
Type Name	Richard A. Gollhofer	Reg. No.	31,106
Signature	Richard A. Gollhofer	Date	1/14/02

Docket No.: 1454.1208

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Rudolf KODES

Serial No. | Group Art Unit:

Confirmation No.

Filed: (concurrently) | Examiner:

For: METHOD AND SYSTEM FOR PRE-PROCESSING (as amended)

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Before examination of the above-identified application, please amend the application as follows:

IN THE TITLE:

Please DELETE the Title in its entirety and REPLACE with the following new Title.

-- METHOD AND SYSTEM FOR PRE-PROCESSING--.

IN THE SPECIFICATION:

Please REPLACE the pending specification with the substitute specification attached hereto.

IN THE CLAIMS:

Please cancel without prejudice or disclaimer claims 1-10 in the underlying PCT application and ADD new claims in accordance with the following:

11. (NEW) A method for optimizing a process model, comprising:

determining effects of components in a process model on other components, the components including actions and results; and

optimizing the process model based on the effects, by at least one of parallelization of components, elimination of at least one component and introduction of a checked intermediate component.

12. (NEW) The method as claimed in claim 11, wherein at least one of the following effects is determined:

influence of at least one result which precedes an action;
influence of an action on at least one subsequent result;
influence of at least one action which precedes a result; and
influence of a result on at least one subsequent action.

13. (NEW) The method as claimed in claim 11, wherein the components are distinguished as results and actions based on significance.

14. (NEW) The method as claimed in claim 13, wherein at least one of the following effects is determined:

influence of at least one result which precedes an action;
influence of an action on at least one subsequent result;
influence of at least one action which precedes a result; and
influence of a result on at least one subsequent action.

15. (NEW) The method as claimed in claim 11, wherein said determining is used to perform a structure analysis.

16. (NEW) The method as claimed in claim 15,

wherein the structure analysis is effected in the form of a map, and

wherein said method further comprises ascertaining a range suitable for optimization based on the map.

17. (NEW) The method as claimed in claim 11, wherein the process model is used to design a technical system after said optimizing.

18. (NEW) A system for optimizing a process model, comprising:

a processor to determine effects of components in a process model on other components, the components including results and actions, and to optimize the process model based on the effects, by at least one of parallelization of components, elimination of at least one component and introduction of a checked intermediate component.

19. (NEW) The system as claimed in claim 18, wherein the components are distinguished as results and actions based on significance.

20. (NEW) The system as claimed in claim 19, wherein said processor determines at least one of the following effects:

influence of at least one result which precedes an action;

influence of an action on at least one subsequent result;

influence of at least one action which precedes a result; and

influence of a result on at least one subsequent action.

21. (NEW) The system as claimed in claim 18, wherein said processor further performs a structure analysis.

22. (NEW) The system as claimed in claim 21,

wherein the structure analysis is effected in the form of a map, and

wherein said processor further ascertains a range suitable for optimization based on the map.

23. (NEW) The system as claimed in claim 18, wherein the process model is used to design a technical system after optimization.

24. (NEW) A system for preprocessing, comprising:

a processor to determine effects of components in a process model on other components, and to perform the preprocessing based on the effects.

25. (NEW) At least one computer readable medium storing at least one computer program to control a processor to perform a method comprising:

determining effects of components in a process model on other components; and

performing preprocessing based on the effects.

IN THE ABSTRACT:

Please DELETE the Abstract in its entirety and replace with the attached Substitute Abstract.

REMARKS

This Preliminary Amendment is submitted to improve the form of the English translation as filed. It is respectfully requested that this Preliminary Amendment be entered in the above-referenced application.

In accordance with the foregoing, claims 1-10 have been canceled and claims 11-25 have been added. Thus, claims 11-25 are pending and are under consideration.

A substitute specification is also being filed herewith. The substitute specification is accompanied by a marked-up copy of the original specification.

If there are any questions regarding these matters, such questions can be addressed by telephone to the undersigned. Otherwise, an early action on the merits is respectfully solicited.

If any further fees are required in connection with the filing of this Preliminary Amendment, please charge same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: 1/14/02

By: Richard A. Gollhofer
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10/030705

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Docket. No. 1454.1208

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	
Rudolf KODES	
Serial No. :	Group Art Unit: (unassigned)
Filed: (concurrently)	Examiner: (unassigned)

For: METHOD, SYSTEM AND COMPUTER PROGRAM FOR PRE-PROCESSING

LETTER TO THE EXAMINER REQUESTING
APPROVAL OF THE CHANGES TO THE DRAWINGS

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

It is respectfully requested that the Examiner having jurisdiction over the subject application approve the amendments to the drawings as indicated in RED on the attached copy of Figure 3.

Respectfully submitted,

STAAS & HALSEY LLP

Dated 1/14/02

By Richard a. Gollhofer
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FIG 1

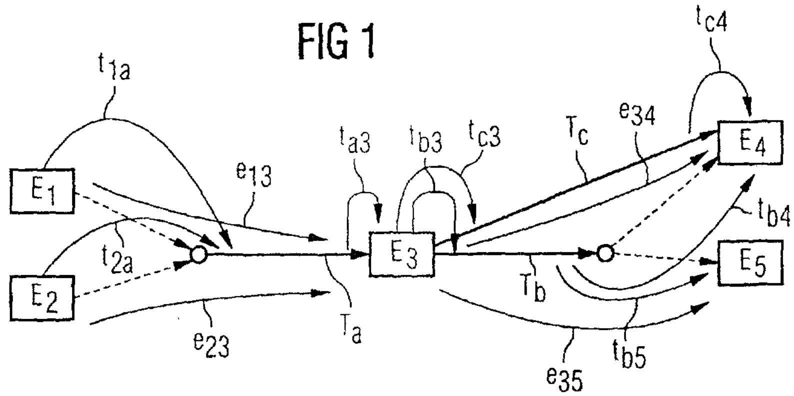


FIG 2

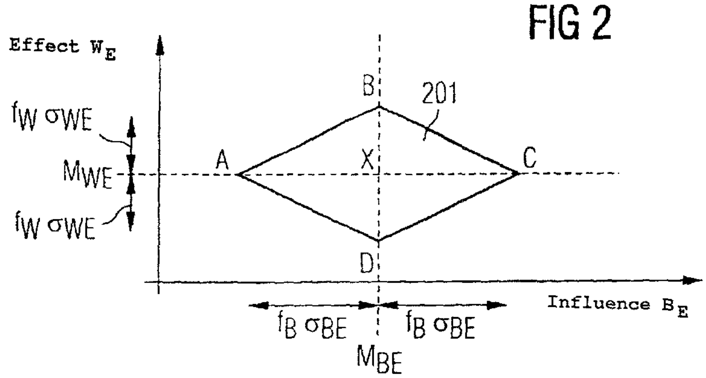
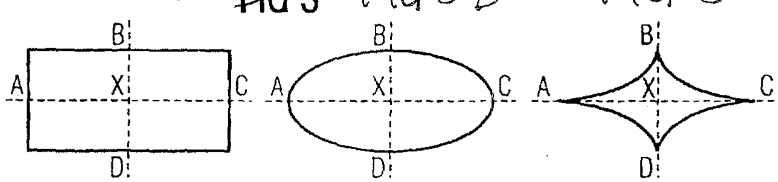


FIG 3A ~~FIG 3~~ FIG 3B FIG 3C



SUBSTITUTE SPECIFICATION

TITLE OF THE INVENTION

METHOD AND SYSTEM FOR PRE-PROCESSING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and hereby claims priority to German Application No. 199 32 945.1 filed on July 14, 1999, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to a method and system for preprocessing.

2. Description of the Related Art

[0003] Within the context of preprocessing, a process model for a technical system is expediently ascertained in one step in the system engineering. Such a process model quickly becomes confusing as the complexity of the technical system increases. Associated with this are sources of error when altering, adjusting and implementing the process model. It is also possible to ascertain a process model for an already existing technical system, with the aim of improving it. Particularly when the real technical system is used as a template for the process model, the model itself quickly becomes confusing; optimization is possible only with difficulty, with enormous complexity and with a high degree of susceptibility to error.

SUMMARY OF THE INVENTION

[0004] The object of the invention is to permit preprocessing which can be used to optimize a process model systematically and in a way which is tolerant of errors.

[0005] In this context, it may be noted that the preprocessing may advantageously be used as an input for further steps, e.g. design, whether it be redesign, adjustment, control or resetting of a technical system. One advantageous feature in this context is, among other things, processing of the data in the process model, so that, by way of example, improved operation of the technical system is then ensured.

[0006] The object is achieved by specifying a method for preprocessing in which effects of components in a process model on other components are determined. The effects are used to perform the preprocessing.

[0007] One refinement in this context is that the preprocessing is an optimization of the process model.

[0008] In particular, the process model can advantageously be ascertained using a multiplicity of components of different type each having different effects. The preprocessing is expediently performed by taking into account the effects of the components. In this context, the interplay of the components among one another is taken into account in the process model. If particular effects which need to be optimized for preprocessing are taken into account, the process model can be improved or optimized for a possibly concrete implementation in the form of a technical system.

[0009] One refinement is that optimization is effected by at least one of the following steps:

a) Parallelization of components:
Parallelization is expediently effected when effects of components are independent in relation to one another. In such a case, parallel processing can be effected.

b) Elimination of a component
A superfluous component can automatically be ascertained and eliminated. The result of this is that superfluous actions can be prevented.

c) Introduction of a checked intermediate component
A large number of components can influence one another greatly. In safety-relevant applications, it is advantageous to provide logical decoupling which can be used to determine states within the process model as safe. Such a state is preferably established using a checked component, in this case an intermediate component, which is inserted additionally.

[0010] One development is that the components are distinguished in the form of results and/or actions according to their significance. Preferably, (combinable) results and (combinable) actions alternate. Hence, the effects on a result or of a result, and vice versa, on an action or of an action, can be determined.

[0011] In this context, the following effects can be determined, in particular:

a) influence of at least one result which precedes an action;
b) influence of an action on at least one subsequent result;
c) influence of at least one action which precedes a result;
d) influence of a result on at least one subsequent action.

[0012] Effects can therefore be regarded as the influencing of a result by preceding results/actions and as the effects of a result on subsequent results/actions.

[0013] Another refinement is that the preprocessing is used to perform a structure analysis. The aim of the structure analysis is to find starting points for optimization in the process model. The process model can be conditioned in terms of its structure, in particular, with the structure analysis making it possible, on the basis of this structure, to determine starting points for optimization. Use can then expediently be made of a process model in the form of a structure representation of the actions and results (alternating with one another).

[0014] Another development is that the result of the preprocessing, in particular the structure, is used for designing a technical system. In this context, the design of the technical system may comprise redesign, adjustment, validation, optimization or control of the technical system.

[0015] The object is also achieved by providing system for preprocessing which comprises a processor unit, which processor unit is set up such that

a) effects of components in a process model on other components can be determined;
b) the effects can be used to perform the preprocessing.

[0016] The object is also achieved by providing a computer program which can be used, when loaded and executed on a processor unit, to perform the following steps:

a) effects of components in a process model on other components are determined;
b) the effects are used to perform the preprocessing.

[0017] The system is particularly suitable for carrying out the inventive method or one of its developments explained above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] These and other objects and advantages of the present invention will become more apparent and more readily appreciated from exemplary embodiments of the invention illustrated and explained below with reference to the drawings, in which:

Figure 1 is a process model diagram showing effects (influences) of results and actions;

Figure 2 is a graph with a two-dimensional coordinate system for classifying results;

Figures 3A-3C are graphs of alternative forms for the coordinate system from Fig. 2;

Figure 4 is a graph with a two-dimensional coordinate system illustrating the significances of the individual ranges for classifying results;

Figure 5 shows changes in a process model diagram for splitting into parallel results (in the case of supplying results);

Figure 6 shows changes in a process model diagram for splitting into a checked result (in the case of supplying results);

Figure 7 shows changes in a process model diagram for splitting into parallel results (in the case of collecting results);

Figure 8 shows changes in a process model diagram for splitting into a checked result (in the case of collecting results);

Figure 9 shows changes in a process model diagram for parallelization in the case of buffering results;

Figure 10 shows changes in a process model diagram for elimination of a result in the case of buffering results;

Figure 11 shows changes in a process model diagram for splitting into parallel results (in the case of critical results);

Figure 12 shows changes in a process model diagram for splitting into a checked result (in the case of critical results);

Figure 13 is a table containing examples of influence B_E on a result by preceding results and actions;

Figure 14 is a block diagram of a processor unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

INFLUENCES OF RESULTS AND ACTIONS

[0020] A result E in an (engineering) process, and hence in a process model, is influenced to a certain extent by all directly preceding results. On the other hand, a result affects all directly subsequent results. Figure 1 shows these influences in a detail of a process model, with each result being identified by e_{ik}. In this context, the following model elements are used for the illustration:

a) box = result,

b) arrow = action

c) dashed arrow = flow of information.

[0021] A result influences a subsequent result if there is at least one connection between these results via actions or flows of information.

[0022] The influence of the i-th result on the k-th result is determined as e_{ik}, where

(1) $0 \leq e_{ik} \leq 1 \qquad i, k \in N.$

[0023] In this context, the value 1 signifies “greatest possible influence”, and the value 0 signifies “no influence”.

[0024] In addition, each action T in an (engineering) process (process model) is influenced to a certain extent by all directly preceding results. On the other side of the coin, an action affects all directly subsequent results.

[0025] Figure 1 shows these influences and respectively identifies them with an indicated “t”.

[0026] There is an influence between a result and the actions arising therefrom directly or via flows of information and also between an action and the results which result therefrom directly or via flows of information.

[0027] The influence of the i-th result on the n-th action is defined as t_{in}, where

(2) $0 \leq t_{in} \leq 1 \qquad i \in N; n \in .$

[0028] Similarly, the influence of the m-th action on the k-th result is defined as t_{mk}, where

(3) $0 \leq t_{mk} \leq 1 \qquad m \in ; k \in N.$

[0029] In this context, the value 1 signifies "greatest possible influence", and the value 0 signifies "no influence".

[0030] By way of example, in Fig. 1:

- t_{2a}: denotes the influence of the result E_2 on the action T_a;
- e_{23}: denotes the influence of the result E_2 on the result E_3;
- t_{a3}: denotes the influence of the action T_a on the result E_3.

Influence on a result

[0031] BE denotes the influence on a result by preceding results and/or actions. The influence on the k-th result is defined as the sum of the influences e_{ik} of all directly preceding results plus the sum of the influences of all directly preceding actions.

(4) $B_{EK} = \sum_i E_{ik} + \sum_m t_{mk}$ $\quad$ $i, k \in N; m \in$

Effect of a result

[0032] W_E denotes the effect of a result on subsequent results and actions. The effect of the i-th result is defined as the sum of the influences e_{ik} on all directly subsequent results plus the sum of the influences on all directly subsequent actions.

(5) $W_{Ei} = \sum_k e_{ik} + \sum_n t_{in}$ $\quad$ $i, k \in N; n \in .$

Influence on an action

[0033] Similarly, B_T denotes the influence on an action by preceding results. The influence on the n-th action is defined as the sum of the influences t_{in} of all directly preceding results.

(6) $B_{Tn} = \sum_i t_{in}$ $\quad$ $i \in N; n \in .$

Effect of an action

[0034] Similarly, W_T denotes the effect of an action on subsequent results. The effect of the m-th action is defined as the sum of the influences t_{mk} on all directly subsequent results

(7) $W_{Tm} = \sum_k t_{mk}$ $\quad$ $k \in N; m \in$

STRUCTURE ANALYSIS

Influences of results and actions in the structure analysis

[0035] A purely structural analysis of the design of process models does not take account, in particular, of the extent of the influences of results and actions; it is merely significant whether or not an influence exists. In the equations (1) to (7), the values e_{ik}, t_{in} and t_{mk} therefore assume the value 1 if an influence exists.

[0036] Alternatively, various influences can be expected; in that case, the values are preferably in a range between 0 and 1 (see above definitions).

[0037] Accordingly, Fig. 1 gives the following for the result E_3:

- influence: $B_{E3} = 2 + 1 = 3$

  (two preceding results and one preceding action)

- effect: $W_{E3} = 2 + 2 = 4$

  (two subsequent results and two subsequent actions)

and the following is obtained for the action T_a:

- influence: $B_{Ta} = 2$

  (two preceding results)

- effect: $W_{Ta} = 1$

  (one subsequent effect)

[0038] Other examples are given in Fig. 13.

Coordinate system for classifying the model elements

[0039] The text below considers the results of a process model. The considerations may be given in a similar manner for actions.

[0040] For each result of a process model, the influence B_E and the effect W_E are ascertained on the basis of equations (4) and (5). In addition, for each of these variables, the arithmetic mean over all results and the standard deviation σ from the mean are formed.

[0041] The arithmetic mean M_{BE} of the influences is obtained on the basis of the following:

(8a) $M_{BE} = \frac{1}{a} \cdot \sum_{k=1}^{a} B_{Ek}$

where a denotes the number of results. The standard deviation σ_{BE} from the mean of the influences is obtained on the basis of the following:

(8b) $$\sigma_{BE} = \sqrt{\frac{1}{a-1} \sum_{k=1}^{a} (B_{Ek} - M_{BE})^2}$$

[0042] The arithmetic mean of the effects is obtained as:

(9a) $M_{WE} = \frac{1}{a} \cdot \sum_{i=1}^{a} W_{Ei}$

[0043] The standard deviation σ_{BE} from the mean of the influences is obtained on the basis of the following:

(9b) $$\sigma_{WE} = \sqrt{\frac{1}{a-1} \sum_{i=1}^{a} (W_{Ei} - M_{WE})^2}$$

[0044] The characteristic quantities "influence" and "effect" and also the respective means and standard deviations can now be used to classify the results. To this end, a coordinate system is determined, on whose abscissa the influence is plotted and on whose ordinate the effect is plotted (cf. Fig. 2).

[0045] This coordinate system shows the straight lines

(10) $B_E = M_{BE}$

and

(11) $W_E = M_{WE}$

[0046] This first produces four ranges in the 1st quadrant of the coordinate system. A fifth range is defined around the point of intersection

(12) $X (M_{BE} ; M_{WE})$

of the two straight lines based on equation (10) and equation (11). To this end, the following points are first ascertained in the coordinate system:

(13) A ($M_{BE} - f_B\,\sigma_{BE}$; M_{WE}),

(14) B (M_{BE} ; $M_{WE} + f_W\,\sigma_{WE}$),

(15) C ($M_{BE} + f_B\,\sigma_{BE}$; M_{WE}),

(16) D (M_{BE} ; $M_{WE} - f_W\,\sigma_{WE}$).

In this case, the factor f_B stipulates the distance of points A and C from the point of intersection X, and f_W stipulates the distance of points B and D from the point of intersection X.

(17) $0 \leq f_B \leq 3$

(18) $0 \leq f_W \leq 3$

give distances in the range between 0 and 3σ.

[0047] Connecting points A to B, B to C, C to D and finally D to A gives a rhombus 201 whose area defines the fifth range. Figure 2 shows the coordinate system and the five ranges.

[0048] For this fifth range 201, other geometric shapes (rectangle, ellipse etc.) are also conceivable. Figure 3 shows some of these. These shapes may be provided as options.

[0049] Significance of the ranges in the coordinate system

[0050] Each model element is sorted into the coordinate system on the basis of its values for influence and effect, and in this context is put into one of the aforementioned five ranges or on the abscissa or the ordinate of the coordinate system. Figure 4 illustrates this:

- a central range 401 contains "inconspicuous" or neutral results. Depending on the process model currently being examined, the factors f_B and f_W and the geometric shape of the central range 401 should be chosen such that this range contains the majority of the results. As a preset, by way of example, the rhombus is chosen for the shape of the central range 401, and, by way of example, $f_B = 1$ and $f_W = 1$ are chosen for the factors.

[0051] The four ranges 402, 403, 404 and 405 outside the central range 401 contain the "conspicuous results".

- The top left range 402 contains results which have intense effects and are themselves influenced little. Accordingly, these are results which predominantly have a supplying character.
- The bottom right range 404 contains greatly influenced results which themselves develop an effect only to a small extent (results with a collecting character).
- The bottom left range 405 contains results which are influenced little and have little effect. These are results with a buffering character.
- The top right range 403 contains results which have an intense effect and are themselves greatly influenced. These are results with a critical character.
- The ordinate 407 of the coordinate system contains results which merely have an effect, that is to say are not influenced themselves. These are purely supplying results (e.g. starting points).
- The abscissa 406 of the coordinate system contains results which are merely influenced and have no effect themselves. These are purely collecting results (e.g. final results).

OPTIMIZATION, STRUCTURE ANALYSIS

[0052] The structure analysis can be used to derive the pointers illustrated below for optimizing the process model.

Neutral results

[0053] These results are inconspicuous in terms of the structure analysis and need not be considered in any further detail in this context.

Supplying results

[0054] These results have an intense effect on a relatively large number of directly subsequent results and actions. Errors or shortcomings in such results can therefore spread many times.

[0055] In terms of their effect, such results should be kept clear and should be reviewed as appropriate.

[0056] For optimization, the following options, in particular, are therefore considered:

⇒ Splitting into parallel partial results which each have fewer effects. Figure 5 shows a result 501 with the four effects 502 to 505. By splitting 506 the result 501, a partial result 507 with the effects 509, 510 and a partial result 508 with the effects 511, 512 are obtained.

⇒ Inserting a review, which is used to ensure that a result exerting a (multiple) effect is reviewed. Figure 6 shows a result 601 with effects 602 to 605. By reviewing 607 the result 606, a checked result 608 with the effects 609 to 612 is obtained.

Collecting results

[0057] These results are influenced by a relatively large number of directly preceding results and actions. The diverse effects, e.g. owing to data from different results and owing to actions from a large number of different workers, mean that such results can lead to difficulties. In particular, prompt production of a product or a technical system may be compromised, clarity of the relationships may be lost on account of the very pronounced collecting character or inconsistencies in the data may arise.

[0058] Such results are carefully reviewed, particularly with regard to a production deadline, are kept clear in terms of content and are checked for consistency after production.

[0059] For optimization, the following options are therefore considered;

⇒ Splitting is performed to produce parallel partial results. In this context, the partial results have fewer influences, the result of which is that their respective content is clear and is easier to keep consistent. Figure 7 shows a result 701 with influences 702 to 705. The splitting is performed such that two influences 707 and 708 act on a result 706, and two influences 710 and 711 act on a result 709. The results 706 and 709 are then combined (see effect 712).

⇒ A review is inserted in order to check the result in terms of the consistency of the diverse collected contents. In Fig. 8, the influences 802 to 805 first have an effect on a result 801. The transformation is now made such that a result 806 affected by influences 807 to 810 is reviewed (cf. review 812) and is thus brought together in a checked result 811.

Buffering results

[0060] These results are influenced little and have little effect. The creation of such results can have a delaying effect or may be quite superfluous. Typical results are those which lie in a

sequential path whose actions can be parallelized, or, by way of example, merely the format of the data contained is converted (e.g. on account of media breakage).

[0061] For optimization, the following options are considered:

⇒ Is parallelization possible?

Figure 9 shows three series-connected results 901, 902 and 903, where an action T_a 904 transfers the result 901 to the result 902, and an action T_b 905 transfers the result 902 to the result 903. Parallelization is now effected so as to establish whether the result 903 is independent of the result 902. If this is the case, then it is possible to move directly from the result 901 to the result 902 and the result 903 in parallel. This fact is shown in Fig. 9 in the arrangement of the results 906, 907 and 908 with respect to one another.

⇒ Is it possible to dispense with the result?

Figure 10 shows the result 1001, 1002, and 1003 in a sequence, where an action T_a 1004 transfers the result 1001 to the result 1002, and an action T_b transfers the result 1002 to the result 1003. If the result 1002 is not absolutely necessary, it can be dispensed with. A change from a result 1006 to a result 1008 is obtained on the basis of an action T_c 1007.

Critical results

[0062] These results are influenced by a relatively large number of directly preceding results and actions. On the other side of the coin, they have an intense effect on a relatively large number of directly subsequent results and actions.

[0063] The diverse effects, e.g. owing to data from different results and owing to actions from a large number of different workers, mean that such results can be problematical. In particular, the prompt production of a system may be compromised, the clarity may be lost on account of the highly collecting character and inconsistencies in the data contained may arise. These problems are particularly critical since the broad effect means that errors or shortcomings in such results can spread many times.

[0064] The results are carefully reviewed with regard to the production deadline, for example, are kept clear in terms of influence, content and effect and are checked thoroughly after production.

[0065] For optimization, the following options are therefore considered:

⇒ Splitting into parallel partial results, with fewer influences and effects in each case (c.f. Fig. 11).

⇒ Splitting into successive results with an intermediate review action which checks the results (cf. Fig. 12).

IMPLEMENTATION, PRODUCTION

Analysis

[0066] Within the context of analyzing a process model and hence a technical system associated with the process model, a map as shown in Fig. 4 is preferably used. The equations (17) and (18) are used to determine the shape of the neutral range. To this end, these equations may be in the form of parts of a model or of a screen surface, e.g. in the form of buttons.

[0067] As presets, the rhombus shape is provided for the neutral range, and the value “1” is provided for the factors of the equations (17) and (18). Alterations to these presets are preferably shown in the coordinate system of Fig. 4.

[0068] After an “Analyze” button has been selected, an analysis algorithm is started. For each result, this algorithm automatically ascertains the values for influence and effect from the graphical structure, i.e. from the links between the individual model elements in the process model. The ascertained values are allocated to the individual results in the process model. This is expediently done using system attributes provided for this purpose. In addition, the means for the influence and effect of all results and the respective standard deviations are calculated.

Presentation of the analysis results

[0069] The result of the analysis is shown, in particular, in the coordinate system:

1. Position and chosen magnitude of the analysis ranges “neutral”, “supplying”, “collecting”, “buffering”, “critical”;
2. Position of the means for influence (influence and effect);

3. Number of results in each of the five analysis ranges ("neutral", "supplying", "collecting", "buffering", "critical") and also n the ordinate ("purely supplying" results) and on the abscissa ("purely collecting" results);
4. Frequency distribution: how many results are there at a particular location in the coordinate system? To this end, the coordinate system is divided up in the manner of a chessboard. Each coordinate having integers is allocated a square on this chessboard. Numbers in the squares on the chessboard indicate how many results there are in each case for a particular coordinate.
5. Listing of all results (e.g. according to their designation) situated in a particular analysis range or on a particular square on the "chessboard"; setting of a desired result.

[0070] After the analysis result has been shown, the factors (see equations (17) and (18)) and the shape of the neutral range can be altered. The alterations are shown in the coordinate system. In particular, the items 1, 3 and 5 in the result presentation are continuously updated in this context.

Determination/identification of conspicuous model elements

[0071] After the analysis has been performed, a button denoted "Color model elements" can be selected. This preferably opens a dialog window which provides options for ways in which each of the five analysis ranges ("neutral", "supplying", "collecting", "buffering", "critical") and also the results which are on the ordinate ("purely supplying") and on the abscissa ("purely collecting") can be highlighted. Preferably, each range has a color pallet for this purpose, with a different color already having been preset for each range. Thus, for example, black is preset for results in the "neutral" range, red is preset for "critical" results etc. The results can be marked with a color in the process model by clicking on the "Color" button.

[0072] Fig. 13 shows a table containing examples of influence B_E on a result by previous results and actions. Figure 13 can be understood per se within the context of the comments above.

[0073] Figure 14 shows a processor unit PRZE. The processor unit PRZE comprises a processor CPU, a memory SPE and an input/output interface IOS which is used in various ways via an interface IFC: a graphical interface is used to display an output on a monitor MON and/or to output it on a printer PRT. A mouse MAS or a keyboard TAST is used to effect input. The processor unit PRZE also has a data bus BUS which ensures connection of a memory MEM,

the processor CPU and the input/output interface IOS. In addition, additional components can be connected to the data bus BUS, e.g. an additional memory, a data memory (hard disk) or a scanner.

[0074] The invention has been described in detail with particular reference to preferred embodiments thereof and examples, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

ABSTRACT

METHOD AND SYSTEM FOR PRE-PROCESSING

Effects of components in a process model on other components are determined. The effects are then used to perform preprocessing.

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Description

Method, arrangement and computer program for preprocessing

The invention relates to a method, an arrangement and a computer program for preprocessing.

Within the context of preprocessing, a process model for a technical system is expediently ascertained in one step in the system engineering. Such a process model quickly becomes confusing as the complexity of the technical system increases. Associated with this are sources of error when altering, adjusting and implementing the process model. It is also possible to ascertain a process model for an already existing technical system, with the aim of improving it. Particularly when the real technical system is used as a template for the process model, the model itself quickly becomes confusing; optimization is possible only with difficulty, with enormous complexity and with a high degree of susceptibility to error.

The object of the invention is to permit preprocessing which can be used to optimize a process model systematically and in a way which is tolerant of errors.

In this context, it may be noted that the preprocessing may advantageously be used as an input for further steps, e.g. design, whether it be redesign, adjustment, control or resetting of a technical system. One advantageous feature in this context is, among other things, processing of the data in the process model, so that, by way of example, improved operation of the technical system is then ensured.

The object is achieved in line with the features of the independent patent claims. Developments of the invention can be found in the dependent claims.

The object is achieved by specifying a method for preprocessing in which effects of components in a process model on other components are determined. The effects are used to perform the preprocessing.

One refinement in this context is that the preprocessing is an optimization of the process model.

In particular, the process model can advantageously be ascertained using a multiplicity of components of different type each having different effects. The preprocessing is expediently performed by taking into account the effects of the components. In this context, the interplay of the components among one another is taken into account in the process model. If particular effects which need to be optimized for said preprocessing are taken into account, the process model can be improved or optimized for a possibly concrete implementation in the form of a technical system.

One refinement is that optimization is effected by at least one of the following steps:

a) Parallelization of components:
Parallelization is expediently effected when effects of components are independent in relation to one another. In such a case, parallel processing can be effected.

b) Elimination of a component
A superfluous component can automatically be ascertained and eliminated. The result of this is that superfluous actions can be prevented.

c) Introduction of a checked intermediate component
A large number of components can influence one another greatly. In safety-relevant

applications, it is advantageous to provide logical decoupling which can be used to determine states within the process model as safe. Such a state is preferably established using a checked component, in this case an intermediate component, which is inserted additionally.

One development is that the components are distinguished in the form of results and/or actions according to their significance. Preferably, (combinable) results and (combinable) actions alternate. Hence, the effects on a result or of a result, and vice versa, on an action or of an action, can be determined.

In this context, the following effects can be determined, in particular:

a) influence of at least one result which precedes an action;
b) influence of an action on at least one subsequent result;
c) influence of at least one action which precedes a result;
d) influence of a result on at least one subsequent action.

Effects can therefore be regarded as the influencing of a result by preceding results/actions and as the effects of a result on subsequent results/actions.

Another refinement is that the preprocessing is used to perform a structure analysis. The aim of the structure analysis is to find starting points for optimization in the process model. The process model can be conditioned in terms of its structure, in particular, with the structure analysis making it possible, on the basis of this structure, to determine starting points for

optimization. Use can then expediently be made of a process model in the form of a structure representation comprising said actions and results (alternating with one another).

Another development is that the result of the preprocessing, in particular the structure, is used for designing a technical system. In this context, the design of the technical system may comprise redesign, adjustment, validation, optimization or control of the technical system.

The object is also achieved by providing an arrangement for preprocessing which comprises a processor unit, which processor unit is set up such that

a) effects of components in a process model on other components can be determined;

b) the effects can be used to perform the preprocessing.

The object is also achieved by providing a computer program which can be used, when loaded and executed on a processor unit, to perform the following steps:

a) effects of components in a process model on other components are determined;

b) the effects are used to perform the preprocessing.

The arrangement and, to the same extent, the computer program are particularly suitable for carrying out the inventive method or one of its developments explained above.

Exemplary embodiments of the invention are illustrated and explained below with reference to the drawings, in which

figure 1 shows a diagram showing effects (influences) of results and actions;

figure 2 shows a coordinate system for classifying results;

figure 3 shows a sketch with alternative forms for the coordinate system from figure 2;

figure 4 shows a coordinate system illustrating the significances of the individual ranges for classifying results;

figure 5 shows splitting into parallel results (in the case of supplying results);

figure 6 shows splitting into a checked result (in the case of supplying results);

figure 7 shows splitting into parallel results (in the case of collecting results);

figure 8 shows splitting into a checked result (in the case of collecting results);

figure 9 shows a sketch with parallelization in the case of buffering results;

figure 10 shows a sketch with elimination of a result in the case of buffering results;

figure 11 shows splitting into parallel results (in the case of critical results);

figure 12 shows splitting into a checked result (in the case of critical results);

figure 13 shows a table containing examples of influence B_E on a result by preceding results and actions;

figure 14 shows a processor unit.

INFLUENCES OF RESULTS AND ACTIONS

A result E in an (engineering) process, and hence in a process model, is influenced to a certain extent by all directly preceding results. On the other side of the coin, a result affects all directly subsequent results. figure 1 shows these influences in a detail of a process model, with each result being identified by e_{ik}. In this context, the following model elements are used for the illustration:

a) box = result,

b) arrow = action

c) dashed arrow = flow of information.

A result influences a subsequent result if there is at least one connection between these results via actions or flows of information.

The influence of the ith result on the kth result is determined as e_{ik}, where

(1) $0 \leq e_{ik} \leq 1$ $i, k \in N$.

In this context, the value 1 signifies "greatest possible influence", and the value 0 signifies "no influence".

In addition, each action T in an (engineering) process (process model) is influenced to a certain extent by

all directly preceding results. On the other side of the coin, an action affects all directly subsequent results.

figure 1 shows these influences and respectively identifies them with an indicated "t".

There is an influence between a result and the actions arising therefrom directly or via flows of information and also between an action and the results which result therefrom directly or via flows of information.

The influence of the ith result on the nth action is defined as t_{in}, where

$$(2)\ 0 \leq t_{in} \leq 1 \qquad i \in N;\ n \in [a, b, c, \ldots].$$

Similarly, the influence of the mth action on the kth result is defined as t_{mk}, where

$$(3)\ 0 \leq t_{mk} \leq 1 \qquad m \in [a, b, c, \ldots];\ k \in N.$$

In this context, the value 1 signifies "greatest possible influence", and the value 0 signifies "no influence".

By way of example, in figure 1:

- t_{2a}: denotes the influence of the result E_2 on the action T_a;
- e_{23}: denotes the influence of the result E_2 on the result E_3;
- t_{a3}: denotes the influence of the action T_a on the result E_3.

Influence on a result

B_E denotes the influence on a result by preceding results and/or actions. The influence on the kth result is defined as the sum of the influences e_{ik} of all directly preceding results plus the sum of the influences of all directly preceding actions.

$$(4)\ B_{EK} = \sum_i E_{ik} + \sum_m t_{mk} \quad i, k \in N;\ m \in [a, b, c, \ldots]$$

Effect of a result

W_E denotes the effect of a result on subsequent results and actions. The effect of the ith

result is defined as the sum of the influences e_{ik} on all directly subsequent results plus the sum of the influences on all directly subsequent actions.

$$(5)\ W_{Ei} = \sum_k e_{ik} + \sum_n t_{in} \quad i, k \in N;\ n \in [a, b, c, \ldots].$$

Influence on an action

Similarly, B_T denotes the influence on an action by preceding results. The influence on the nth action is defined as the sum of the influences t_{in} of all directly preceding results.

$$(6)\ B_{Tn} = \sum_i t_{in} \qquad i \in N;\ n \in [a, b, c, \ldots].$$

Effect of an action

Similarly, W_T denotes the effect of an action on subsequent results. The effect of the mth action is defined as the sum of the influences t_{mk} on all directly subsequent results

$$(7)\ W_{Tm} = \sum_k t_{mk} \qquad k \in N;\ m \in [a, b, c, \ldots]$$

STRUCTURE ANALYSIS

Influences of results and actions in the structure analysis

A purely structural analysis of the design of process models does not take account, in particular, of the extent of the influences of results and actions; it is merely significant whether or not an influence exists. In the equations (1) to (7), the values e_{ik}, t_{in} and t_{mk} therefore assume the value 1 if an influence exists.

Alternatively, various influences can be expected; in that case, the values are preferably in a range between 0 and 1 (see above definitions).

Accordingly, figure 1 gives the following for the result E_3:

- influence: $B_{E3} = 2 + 1 = 3$

  (two preceding results and one preceding action)
- effect: $W_{E3} = 2 + 2 = 4$

  (two subsequent results and two subsequent actions)

and the following is obtained for the action T_a:

- influence: $B_{Ta} = 2$

  (two preceding results)
- effect: $W_{Ta} = 1$

  (one subsequent effect)

Other examples are given in figure 13.

Coordinate system for classifying the model elements

The text below considers the results of a process model. The considerations may be given in a similar manner for actions.

For each result of a process model, the influence B_E and the effect W_E are ascertained on the basis of equations (4) and (5). In addition, for each of these variables, the arithmetic mean over all results and the standard deviation σ from the mean are formed.

The arithmetic mean M_{BE} of the influences is obtained on the basis of the following:

$$\text{(8a)} \quad M_{BE} \quad \frac{1}{a} \cdot \sum_{k=1}^{a} B_{Ek}$$

where a denotes the number of results. The standard deviation σ_{BE} from the mean of the influences is obtained on the basis of the following:

$$\text{(8b)} \quad \sigma_{BE} = \sqrt{\frac{1}{a-1}\sum_{k=1}^{a}(B_{Ek} - M_{BE})^2}$$

The arithmetic mean of the effects is obtained as:

$$\text{(9a)} \quad M_{WE} = \frac{1}{a} \cdot \sum_{i=1}^{a} W_{Ei}$$

The standard deviation σ_{BE} from the mean of the influences is obtained on the basis of the following:

$$\text{(9b)} \quad \sigma_{WE} = \sqrt{\frac{1}{a-1}\sum_{i=1}^{a}(W_{Ei} - M_{WE})^2}$$

The characteristic quantities "influence" and "effect" and also the respective means and standard deviations can now be used to classify the results. To this end, a coordinate system is determined, on whose abscissa the influence is plotted and on whose ordinate the effect is plotted (cf. figure 2).

This coordinate system shows the straight lines

(10) $B_E = M_{BE}$

and

(11) $W_E = M_{WE}$

This first produces four ranges in the 1st quadrant of the coordinate system.

A fifth range is defined around the point of intersection

(12) $X\ (M_{BE}\ ;\ M_{WE})$

of the two straight lines based on equation (10) and equation (11). To this end, the following points are first ascertained in the coordinate system:

(13) A $(M_{BE} - f_B \sigma_{BE} ; M_{WE})$,

(14) B $(M_{BE} ; M_{WE} + f_W \sigma_{WE})$,

(15) C $(M_{BE} + f_B \sigma_{BE} ; M_{WE})$,

(16) D $(M_{BE} ; M_{WE} - f_W \sigma_{WE})$.

In this case, the factor f_B stipulates the distance of points A and C from the point of intersection X, and f_W stipulates the distance of points B and D from the point of intersection X.

(17) $0 \leq f_B \leq 3$

(18) $0 \leq f_W \leq 3$

give distances in the range between 0 and 3σ.

Connecting points A to B, B to C, C to D and finally D to A gives a rhombus 201 whose area defines the fifth range. figure 2 shows the coordinate system and the five ranges.

For this fifth range 201, other geometric shapes (rectangle, ellipse etc.) are also conceivable. figure 3 shows some of these. These shapes may be provided as options.

Significance of the ranges in the coordinate system

Each model element is sorted into the coordinate system on the basis of its values for influence and effect, and in this context is put into one of the aforementioned five ranges or on the abscissa or the ordinate of the coordinate system. figure 4 illustrates this:

- a central range 401 contains "inconspicuous" or neutral results. Depending on the process model currently being examined, the factors f_B and f_W and the geometric shape of the central range 401 should be chosen such that this range contains the majority

of the results. As a preset, by way of example, the rhombus is chosen for the shape of the central range 401, and, by way of example, $f_B = 1$ and $f_W = 1$ are chosen for the factors.

The four ranges 402, 403, 404 and 405 outside the central range 401 contain the "conspicuous results".

- The top left range 402 contains results which have intense effects and are themselves influenced little. Accordingly, these are results which predominantly have a supplying character.
- The bottom right range 404 contains greatly influenced results which themselves develop an effect only to a small extent (results with a collecting character).
- The bottom left range 405 contains results which are influenced little and have little effect. These are results with a buffering character.
- The top right range 403 contains results which have an intense effect and are themselves greatly influenced. These are results with a critical character.
- The ordinate 407 of the coordinate system contains results which merely have an effect, that is to say are not influenced themselves. These are purely supplying results (e.g. starting points).
- The abscissa 406 of the coordinate system contains results which are merely influenced and have no effect themselves. These are purely collecting results (e.g. final results).

OPTIMIZATION, STRUCTURE ANALYSIS

The structure analysis can be used to derive the pointers illustrated below for optimizing the process model.

Neutral results

These results are inconspicuous in terms of the structure analysis and need not be considered in any further detail in this context.

Supplying results

These results have an intense effect on a relatively large number of directly subsequent results and actions. Errors or shortcomings in such results can therefore spread many times.

In terms of their effect, such results should be kept clear and should be reviewed as appropriate.

For optimization, the following options, in particular, are therefore considered:

⇒ Splitting into parallel partial results which each have fewer effects. figure 5 shows a result 501 with the four effects 502 to 505. By splitting 506 the result 501, a partial result 507 with the effects 509, 510 and a partial result 508 with the effects 511, 512 are obtained.

⇒ Inserting a review, which is used to ensure that a result exerting a (multiple) effect is reviewed. figure 6 shows a result 601 with effects 602 to 605. By reviewing 607 the result 606, a checked result 608 with the effects 609 to 612 is obtained.

Collecting results

These results are influenced by a relatively large number of directly preceding results and actions. The diverse effects, e.g. owing to data from different results and owing to actions from a large number

of different workers, mean that such results can lead to difficulties. In particular, prompt production of a product or a technical system may be compromised, clarity of the relationships may be lost on account of the very pronounced collecting character or inconsistencies in the data may arise.

Such results are carefully reviewed, particularly with regard to a production deadline, are kept clear in terms of content and are checked for consistency after production.

For optimization, the following options are therefore considered;

⇒ Splitting is performed to produce parallel partial results. In this context, the partial results have fewer influences, the result of which is that their respective content is clear and is easier to keep consistent. figure 7 shows a result 701 with influences 702 to 705. The splitting is performed such that two influences 707 and 708 act on a result 706, and two influences 710 and 711 act on a result 709. The results 706 and 709 are then combined (see effect 712).

⇒ A review is inserted in order to check the result in terms of the consistency of the diverse collected contents. In figure 8, the influences 802 to 805 first have an effect on a result 801. The transformation is now made such that a result 806 affected by influences 807 to 810 is reviewed (cf. review 812) and is thus brought together in a checked result 811.

Buffering results

These results are influenced little and have little effect. The creation of such results can have a delaying effect or may be quite superfluous. Typical results are those which lie in a sequential path whose actions can be parallelized, or, by way of example, merely the format of the data contained is converted (e.g. on account of media breakage).

For optimization, the following options are considered:

⇒ Is parallelization possible?
figure 9 shows three series-connected results 901, 902 and 903, where an action T_a 904 transfers the result 901 to the result 902, and an action T_b 905 transfers the result 902 to the result 903. Parallelization is now effected so as to establish whether the result 903 is independent of the result 902. If this is the case, then it is possible to move directly from the result 901 to the result 902 and the result 903 in parallel. This fact is shown in figure 9 in the arrangement of the results 906, 907 and 908 with respect to one another.

⇒ Is it possible to dispense with the result?
figure 10 shows the result 1001, 1002, and 1003 in a sequence, where an action T_a 1004 transfers the result 1001 to the result 1002, and an action T_b transfers the result 1002 to the result 1003. If the result 1002 is not absolutely necessary, it can be dispensed with. A change from a result 1006 to a result 1008 is obtained on the basis of an action T_c 1007.

Critical results

These results are influenced by a relatively large number of directly preceding results and actions. On the other side of the coin, they have an intense effect on a relatively large number of directly subsequent results and actions.

The diverse effects, e.g. owing to data from different results and owing to actions from a large number of different workers, mean that such results can be problematical. In particular, the prompt production of a system may be compromised, the clarity may be lost on account of the highly collecting character and inconsistencies in the data contained may arise. These problems are particularly critical since the broad effect means that errors or shortcomings in such results can spread many times.

The results are carefully reviewed with regard to the production deadline, for example, are kept clear in terms of influence, content and effect and are checked thoroughly after production.

For optimization, the following options are therefore considered:

⇒ Splitting into parallel partial results, with fewer influences and effects in each case (c.f. figure 11).

⇒ Splitting into successive results with an intermediate review action which checks the results (cf. figure 12).

IMPLEMENTATION, PRODUCTION

Analysis

Within the context of analyzing a process model and hence a technical system associated with the process model, a map as shown in figure 4 is preferably used. The equations (17) and (18) are used to determine the shape of the neutral range. To this end, these equations may be in the form of parts of a model or of a screen surface, e.g. in the form of buttons.

As presets, the rhombus shape is provided for the neutral range, and the value "1" is provided for the factors of the equations (17) and (18). Alterations to these presets are preferably shown in the coordinate system of figure 4.

After an "Analyze" button has been selected, an analysis algorithm is started. For each result, this algorithm automatically ascertains the values for influence and effect from the graphical structure, i.e. from the links between the individual model elements in the process model. The ascertained values are allocated to the individual results in the process model. This is expediently done using system attributes provided for this purpose. In addition, the means for the influence and effect of all results and the respective standard deviations are calculated.

Presentation of the analysis results

The result of the analysis is shown, in particular, in the coordinate system:

1. Position and chosen magnitude of the analysis ranges "neutral", "supplying", "collecting", "buffering", "critical";

2. Position of the means for influence (influence and effect);

3. Number of results in each of the five analysis ranges ("neutral", "supplying", "collecting", "buffering",

"critical") and also on the ordinate ("purely supplying" results) and on the abscissa ("purely collecting" results);

4. Frequency distribution: how many results are there at a particular location in the coordinate system? To this end, the coordinate system is divided up in the manner of a chessboard. Each coordinate having integers is allocated a square on this chessboard. Numbers in the squares on the chessboard indicate how many results there are in each case for a particular coordinate.
5. Listing of all results (e.g. according to their designation) situated in a particular analysis range or on a particular square on the "chessboard"; setting of a desired result.

After the analysis result has been shown, the factors (see equations (17) and (18)) and the shape of the neutral range can be altered. The alterations are shown in the coordinate system. In particular, the items 1, 3 and 5 in the result presentation are continuously updated in this context.

Determination/identification of conspicuous model elements

After the analysis has been performed, a button denoted "Color model elements" can be selected. This preferably opens a dialog window which provides options for ways in which each of the five analysis ranges ("neutral", "supplying", "collecting", "buffering", "critical") and also the results which are on the ordinate ("purely supplying") and on the abscissa ("purely collecting") can be highlighted. Preferably, each range has a color pallet for this purpose, with a different color already having been preset for each range. Thus, for example, black is preset for results in the "neutral" range,

red is preset for "critical" results etc. The results can be marked with a color in the process model by clicking on the "Color" button.

figure 13 shows a table containing examples of influence B_E on a result by previous results and actions. figure 13 can be understood per se within the context of the comments above.

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Patent claims

1. A method for preprocessing,
   a) in which effects of components in a process model on other components are determined;
   b) in which the effects are used to perform the preprocessing.

2. The method as claimed in claim 1,
   in which the preprocessing is an optimization of the process model.

3. The method as claimed in claim 2,
   in which optimization is effected by at least one of the following steps:
   a) parallelization of components;
   b) elimination of a component;
   c) introduction of a checked intermediate component

4. The method as claimed in one of the preceding claims,
   in which the components are distinguished as results and actions according to their significance.

5. The method as claimed in claim 4,
   in which at least one of the following effects is determined;
   a) influence of at least one result which precedes an action;
   b) influence of an action on at least one subsequent result;
   c) influence of at least one action which precedes a result;
   d) influence of a result on at least one subsequent action.

6. The method as claimed in one of the preceding claims, in which the preprocessing is used to perform a structure analysis.

7. The method as claimed in claim 6, in which the structure analysis is effected in the form of a map, with the map being used to ascertain a range suitable for optimization.

8. The method as claimed in one of the preceding claims, in which the result of the preprocessing is used for designing a technical system.

9. An arrangement for preprocessing, in which a processor unit is provided which is set up such that
   a) effects of components in a process model on other components can be determined;
   b) the effects can be used to perform the preprocessing.

10. A computer program which can be used, when loaded and executed on a processor unit, to perform the following steps:
   a) effects of components in a process model on other components are determined;
   b) the effects are used to perform the preprocessing.

GR 99 P 2289

Abstract

Method, arrangement and computer program for preprocessing

The invention specifies a method for preprocessing in which effects of components in a process model on other components are determined. The effects are used to perform the preprocessing.

GR 99 P 2289

FIG 1

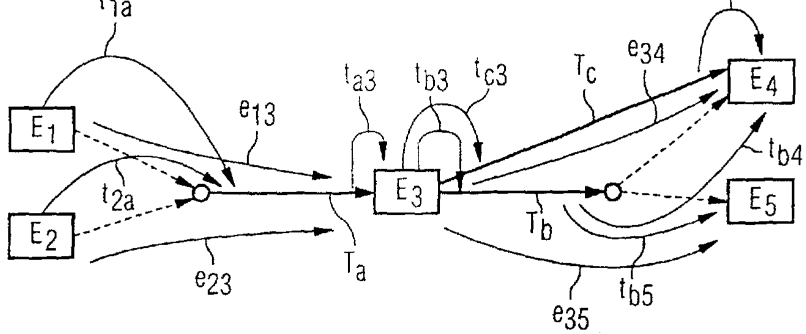


FIG 2

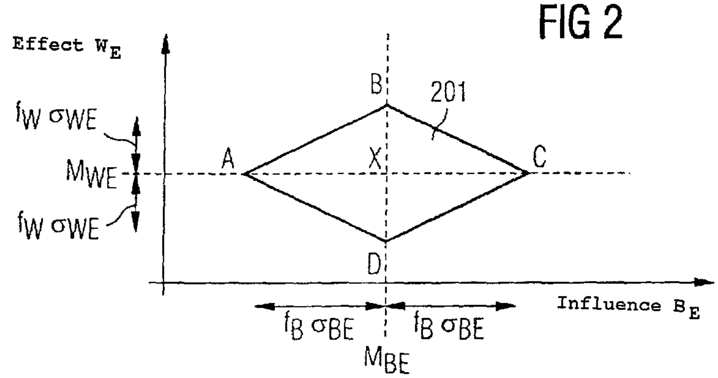
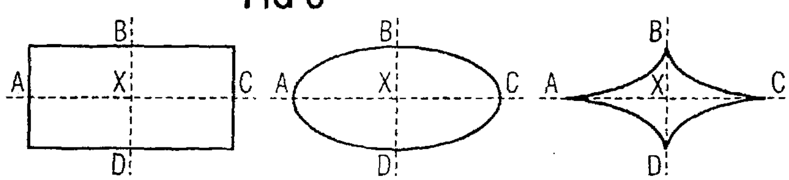


FIG 3



GR 99 P 2289

FIG 4

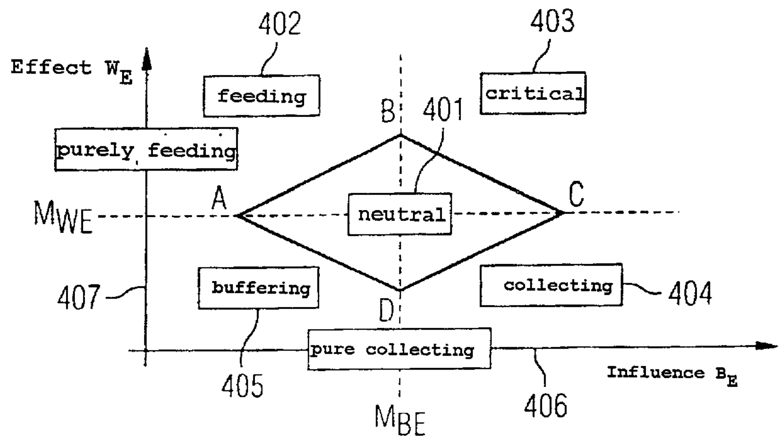


FIG 5

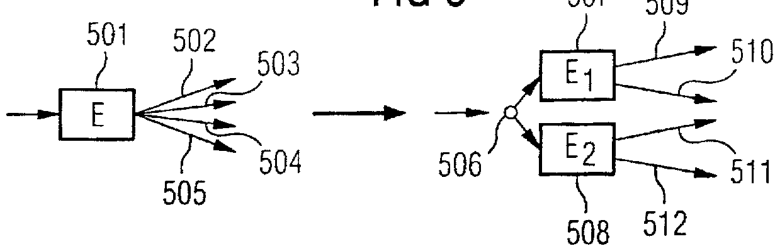


FIG 6

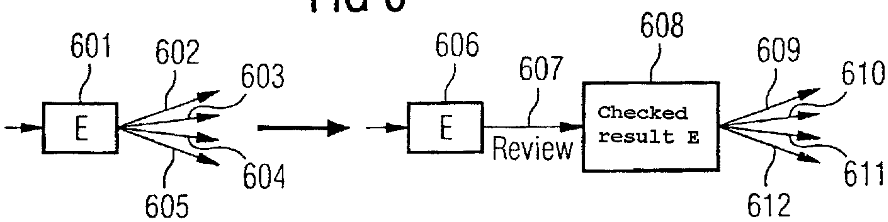


FIG 7

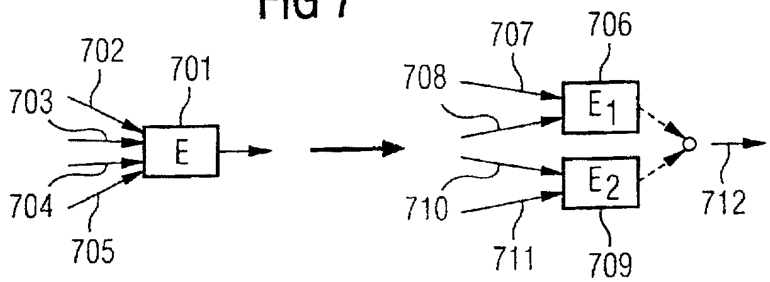


FIG 8

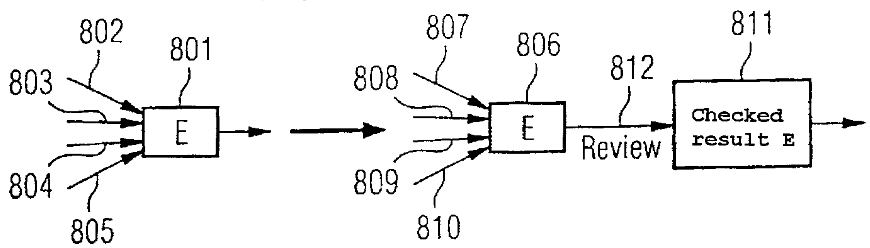


FIG 9

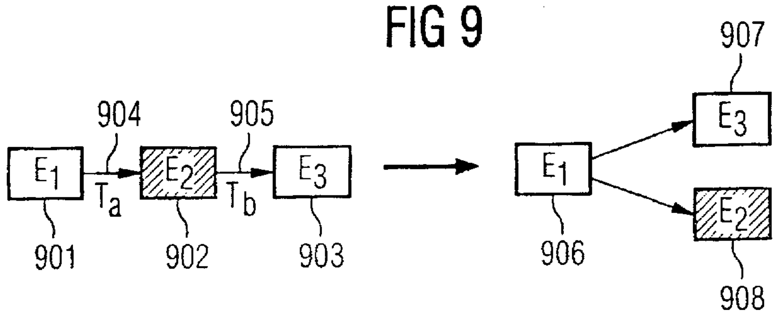


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FIG 10

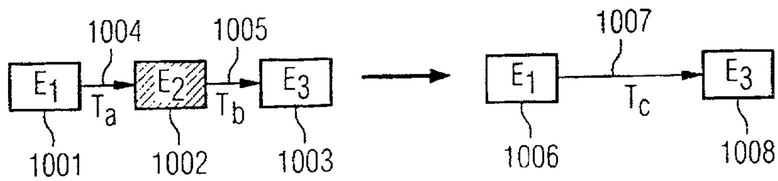


FIG 11

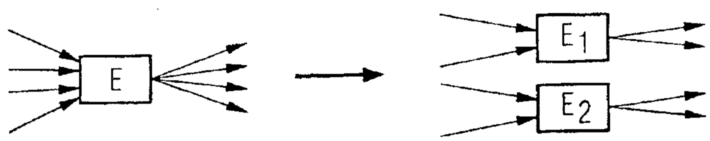


FIG 12

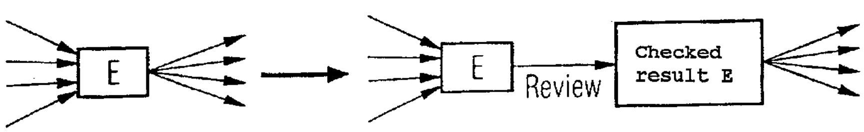


FIG 13

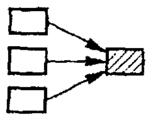
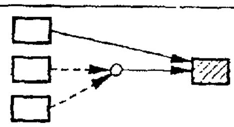
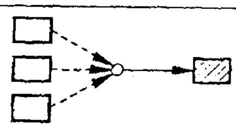
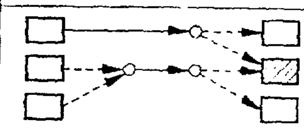
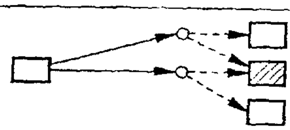
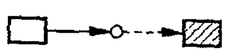
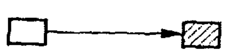
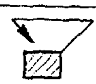
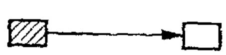
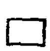
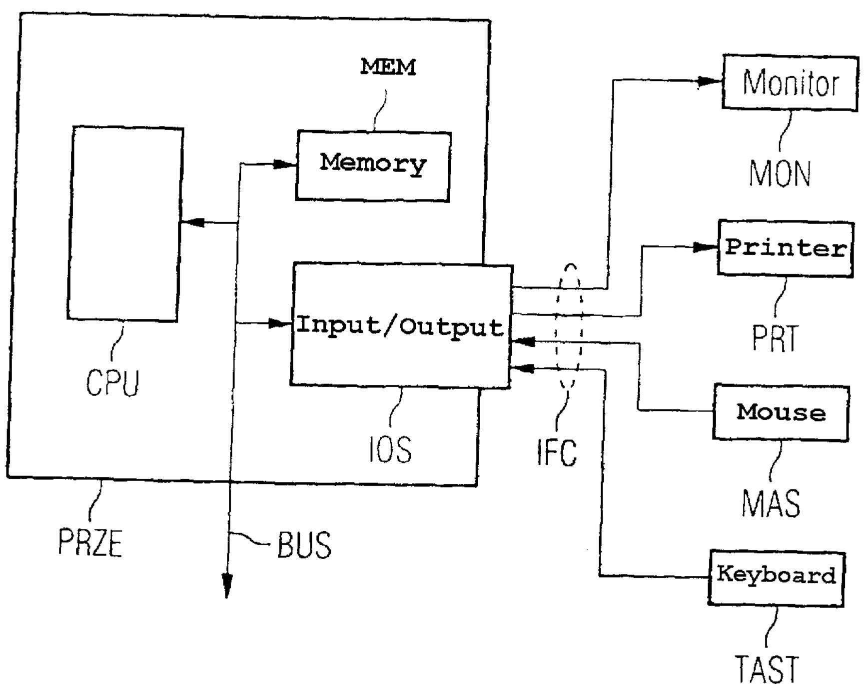
Structure	Influencing results	Influencing actions	Influence B_E
	3	3	6
	3	2	5
	3	1	4
	3	2	5
	1	2	3
	1	2	3
	1	1	2
	1	1	2
	1	1	2
	0	0	0
	0	0	0

FIG 14


MEM
Memory
CPU
Input/Output
IOS
PRZE
BUS
IFC
Monitor
MON
Printer
PRT
Mouse
MAS
Keyboard
TAST

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

Verfahren, Anordnung und Computerprogramm zur Vorverarbeitung

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 13.07.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/02299
eingereicht wurde und am ______
abgeändert wurde (falls tatsächlich abgeändert).

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Method, system and computer program for pre-processing

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 13.07.2000 as
PCT international application
PCT Application No. PCT/DE00/02299
and was amended on ______
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign appplications
Prioritāt beansprucht

Priority Claimed

19932945.1 (Number) (Nummer)	DE (Country) (Land)	14.07.1999 (Day Month Year Filed) (Tag Monat Jahr eingereicht)	☒ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/02299 (Application Serial No.) (Anmeldeseriennummer)	13.07.2000 (Filing Date D, M, Y) (Anmeldedatum T, M, J)	anhängig (Status) (patentiert, anhängig, aufgegeben)	pending (Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: *(Name und Registrationsnummer anführen)*	POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

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Telefongespräche bitte richten an: *(Name und Telefonnummer)*	Direct Telephone Calls to: *(name and telephone number)* Ext. ______
Postanschrift:	Send Correspondence to:

Staas & Halsey LLP
700 Eleventh Street NW, Suite 500 20001 Washington, DC
Telephone: (001) 202 434 1500 and Facsimile (001) 202 434 1501
or
Customer No. 21171

Voller Name des einzigen oder ursprünglichen Erfinders: RUDOLF KODES	Full name of sole or first inventor: RUDOLF KODES
Unterschrift des Erfinders: Rudolf Kodes — Datum: 21. Dez. 2001	Inventor's signature: Rudolf Kodes — Date: 21. Dez. 2001
Wohnsitz: OBERASBACH, DEUTSCHLAND	Residence: OBERASBACH, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: STIFTSTR. 8	Post Office Addess: STIFTSTR. 8
90522 OBERASBACH	90522 OBERASBACH
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any:
Unterschrift des Erfinders — Datum	Second Inventor's signature — Date
Wohnsitz: ,	Residence: ,
Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

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